

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference SKF120011505 | FOR FURTHER ACTION See Form PCT/IPEA/416 | |
| International application No. PCT/FI 2002/000611 | International filing date (day/month/year) 04.07.2002 | Priority date (day/month/year) 10.07.2001 |
| International Patent Classification (IPC) or national classification and IPC D21C 11/12 | | |
| Applicant Fortum OYJ et al | | |

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
- a. ☒ (sent to the applicant and to the International Bureau) a total of 2 sheets, as follows:
- ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
- ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
- b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input checked="" type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

| | |
|---|---|
| Date of submission of the demand 09.01.2004 | Date of completion of this report 20.10.2004 |
| Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88 | Authorized officer Susanna Lindfors/Els Telephone No. +46 8 782 25 00 |

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/FI 2002/000611

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
☐ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

☐ the international application as originally filed/furnished

☒ the description:

pages 1 - 11 _____ as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished

pages* _____ as amended (together with any statement) under Article 19

pages* 13 - 14 received by this Authority on 11.06.2004

pages* _____ received by this Authority on _____

☒ the drawings:

pages 1 - 2 _____ as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing (*specify*): _____

☐ any table(s) related to the sequence listing (*specify*): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing (*specify*): _____

☐ any table(s) related to the sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

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Box No. IV Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is:

- ☐ complied with.
- ☒ not complied with for the following reasons:

The following separate inventions were identified:

I: Claim 1 is directed to a method for treatment of spent liquor at a pulp mill, which liquor contains sulphur compounds derived from the cooking chemicals. The method is especially suitable for the treatment of black liquor.

II: Claim 6 is directed to a method for treatment of spent liquor at a pulp mill, which liquor results from cooking with an organic solvent.

The present application has been considered to contain two inventions which are not linked such that they form a single general inventive concept, as required by Rule 13 PCT for the following reasons:

The problem to be solved by the invention I is to provide a method for the treatment of spent pulping liquor, containing inorganic cooking chemicals. The method comprises pyrolysis of the spent pulping liquor and a subsequent gasification step, whereupon the cooking chemicals are recovered from the coke thus produced.

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4. Consequently, this report has been established in respect of the following parts of the international application:

- ☒ all parts.
- ☐ the parts relating to claims Nos. _____

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX IV

The problem to be solved by the invention II is to provide a method for the treatment of spent pulping liquor, derived from cooking with an organic solvent. The method comprises pyrolysis of the spent pulping liquor, whereupon the cooking chemicals, i.e. the organic solvent, are recovered from the evaporable compounds produced in the pyrolysis.

The only common technical feature unifying claim 1 and claim 6, is the use of pyrolysis as one sub-step for treatment of spent liquor at a pulp mill.

However, the teaching that pyrolysis can be used for the treatment of spent pulping liquor is previously known from document US 4135968.

Consequently, neither the problems underlying the subjects of the two claimed inventions, nor their solutions, allow for a relationship to be established between the said inventions, which involves a single general inventive concept in the sense of Rule 13.1 PCT

No other features can be distinguished which can be considered as same or corresponding special technical features in the sense of Rule 13.2 PCT.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: BOX V

part of the spent liquor flow arriving from the evaporation plant is taken to the pyrolysis reactor, whereas a second part of the spent liquor flow is taken to a soda recovery boiler.

There is no evidence on file that shows that this distinguishing feature gives rise to an effect in a non obvious manner. Therefore, the problem to be solved by the method of claim 2 can be seen as being to provide an alternative method to the one disclosed in D1.

However, from D2 it is previously known to divide the spent pulping liquor into two flows, whereupon one part is taken to a pyrolysis reactor, and the second part is taken directly to a soda recovery boiler.

It is considered obvious to a person skilled in the art to use the teaching of D2 in a method as the one disclosed in D1, so as to arrive at the invention according to claim 2. Consequently, the method according to claim 2 is considered obvious to a person skilled in the art.

The subject matters of claims 3 - 5 are also considered obvious to a person skilled in the art, especially since it is previously known from D2 to use the gas produced from the spent liquor in the pyrolysing unit as fuel.

It is also considered obvious to a person skilled in the art to choose the pyrolysis conditions according to the desired products. Consequently, the subject matters according to claims 9 and 10 are considered obvious to a person skilled in the art.

D3 refers to a process for the recovery of energy and kraft pulping chemicals in a system of multiple reactors. The method comprises pyrolysing kraft black liquor at a temperature of not more than 600 C, whereafter the sulphur compounds contained in the char are reduced to sulphide in a heated reducer. The reduced char is leached with an aqueous leaching liquid to leach inorganic salts comprising carbonates and sulphides. The aqueous liquid thus formed is recovered as green liquor. In the reducing step described in D3, gasification also occurs, whereby the reducing step can be

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|-------------------------------|--------|----------------------|-----|
| Novelty (N) | Claims | <u>2 - 10</u> | YES |
| | Claims | <u>1</u> | NO |
| Inventive step (IS) | Claims | <u>6</u> | YES |
| | Claims | <u>1 - 5, 7 - 10</u> | NO |
| Industrial applicability (IA) | Claims | <u>1 - 10</u> | YES |
| | Claims | | NO |

2. Citations and explanations (Rule 70.7)

Reference is made to the following documents:

D1: US 3607619 A
D2: US 4135968 A
D3: US 5174860 A

D1 refers to a process for the treatment of black liquor from kraft pulp mills comprising coking said black liquor at a temperature in the range of about 450 - 700 °F (232 - 371 °C), in the absence of added free oxygen. During the coking process, organic components of the black liquor are decomposed and dehydrated to a carbonized solid or coke which is discharged at the end of the coking period. The discharged coke may be burned to supply heat for the process and to recover chemicals, such as sodium sulfide and sodium carbonate, contained therein.

It is not explicitly stated in D1 that the coke is taken to a gasification reactor for gasification. However, since sodium sulfide is also recovered from the coke in the process described in D1, the same conditions must prevail in the burning process referred to in D1, as in the gasification process referred to in claim 1. Thus, the burning of the coke described in D1 is considered to be equivalent to the gasification of the coke as stated in claim 1.

Consequently, the method according to claim 1 lacks novelty.

The method according to claim 2 differs from D1 in that only a

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

seen as a gasification step under reducing conditions. Air is introduced into the fluid bed pyrolyser and used in the pyrolysing step for temperature control and as a fluidizing medium.

The invention as defined in claims 1 - 6 and 9 - 10 differs from D3 in that the pyrolysis is preformed in the absence of an external gas component.

However, since it is well known in the art to pyrolyse spent pulping liquor without the addition of external gases, the invention as defined in claims 1 - 6 and 9 - 10 is considered to lack an inventive step also in view of D3.

It is also considered obvious to a person skilled in the art to arrange the pyrolysis reactor for a batch or for a continuous process. Therefore, also the method according to claims 7 and 8 is considered obvious to a person skilled in the art.

The method according to claim 6 differs from the cited documents in that it refers to the recovery of an organic solvent. In the method according to claim 6, the spent liquor is divided into a solids portion and an evaporated portion, and the cooking chemicals, i.e. the organic solvent, is contained in the latter one. None of the documents D1 - D3 teaches a method suitable for treatment of spent liquors resulting from cooking with an organic solvent.

There is no indication in any of the documents, D1 - D3, that would lead a person skilled in the art to the method claimed in claim 6. Consequently, the method according to claim 6 is novel and considered to involve an inventive step.

Accordingly, the method according to claim 1 lacks novelty. The method according to claims 2 - 5 and 7 - 10 is novel, but considered to lack an inventive step. The method according to claim 6 is novel and considered to fulfill the requirement of inventive step. The invention is industrially applicable.

Amended Claims

1. Method for treatment of spent liquor at a pulp mill, especially for treatment of black liquor, in order to recover its contents of chemicals and energy, **character-**
5 **ised** in that a spent liquor flow (10) arriving from the evaporation plant is taken to a pyrolysis reactor (1), wherein it is pyrolysed at a temperature of 300-800°C in the absence of an external gas component in order to separate evaporable compounds (12) from the coke (11) remaining in a solid state, whereupon the evaporable compounds (12) are recovered and the coke (11) is taken to a
10 gasification reactor (3) for gasification, which gasification is implemented under such conditions that the sulphur compounds contained in the coke (11) and deriving from the cooking chemicals are reduced to sodium sulphide.
2. Method according to claim 1, **characterised** in that only a part of the spent
15 liquor flow (10) arriving from the evaporation plant is taken to the pyrolysis reactor (1), whereas a second part of the spent liquor flow (10) is taken to a soda recovery boiler (3) where it is burnt in order to recover its contents of chemicals and energy.
- 20 3. Method according to claim 1 or 2, **characterised** in that the evaporable compounds (12) separated from the spent liquor in the pyrolysis reactor (1) are used at the mill as fuel in part or entirely.
- 25 4. Method according to claim 1 or 2, **characterised** in that the evaporable compounds (12) separated from the spent liquor in the pyrolysis reactor (1) are processed further.
5. Method according to claim 1 or 2, **characterised** in that the product gases (14) resulting from the gasification are used at the mill as fuel in part or entirely.
- 30 6. Method for treatment of spent liquor at a pulp mill in which cooking is carried

out with an organic solvent in order to recover its contents of chemicals and energy, **characterised** in that the spent liquor flow (10) arriving from the evaporation plant is taken to a pyrolysis reactor (1), wherein it is pyrolysed at a temperature of 300-800°C in the absence of an external gas component in order to
5 separate evaporable compounds (12) from the coke (11) remaining in a solid state, whereupon the evaporable compounds are recovered and used at the mill as process chemicals in part or entirely, and the coke is taken to a fluidised-bed boiler or some other combustion equipment (4) for burning in order to recover the energy content of the coke.

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7. Method according to any one of claims 1-6, **characterised** in that the pyrolysis reactor (1) is for a batch process, whereby increasing of the temperature may begin from the temperature of the spent liquor arriving in the reactor, while the final temperature is chosen according to the desired final products.

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8. Method according to any one of claims 1-6, **characterised** in that the pyrolysis reactor (1) is for a continuous process.

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9. Method according to any one of claims 1-8, **characterised** in that the pyrolysis is carried out in such process conditions (temperature, pressure, residence time, heating speed, etc.), wherein the evaporable compounds (12) mainly consist of non-condensing gases.

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10. Method according to any one of claims 1-8, **characterised** in that the pyrolysis is carried out in such process conditions (temperature, pressure, residence time, heating speed, etc.), wherein the evaporable compounds (12) mainly consist of pyrolysis oil.